

<sup>1</sup> *Authorization and Use of Software Defined Radios*, ET Docket No. 00-47, *Notice of Proposed Rulemaking*, 15 F.C.C.R. 2442 (2000) (“*NPRM*”).

## **I. SDR WILL HAVE NO IMPACT ON SPECTRUM ALLOCATION POLICIES FOR AT LEAST TEN YEARS**

Most commenters, including Cingular, acknowledge that SDR has the *potential* to lead to improvements in spectral efficiency.<sup>2</sup> Spectral efficiency, however, will not be directly caused by SDR deployment. Rather, SDR will make it economically viable for carriers to implement *other* spectrally efficient technologies, such as fully adaptive smart antennas.<sup>3</sup> Thus, although SDR may lead to improvements in spectral efficiency, SDR will not be the direct cause of these improvements. Because SDR will have no direct impact on spectral efficiency, there should be little or no noticeable short-term benefits from SDR deployment.<sup>4</sup> Given that these benefits will occur only in conjunction with the deployment of spectrally efficient technologies, Cingular estimates that it will be at least ten years before there will be any improvement on spectrum efficiency that can be attributable (indirectly) to SDR deployment.<sup>5</sup>

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<sup>2</sup> See, e.g., Cingular Comments at 1-3, 8-9; AirNet Communications, Inc. Comments at 2; American Petroleum Institute (“API”) Comments at 3; Clearwire Technologies, Inc. Comments at 1-3; Hypres, Inc. Comments at 3-4; Intel Corporation Comments at 2; SDR Forum Comments at 2; Nortel Networks Inc. Comments at 1-2; Vanu, Inc. Comments at 3-4.

<sup>3</sup> Cingular Comments at 2.

<sup>4</sup> Cf. AirNet Comments at 2; Clearwire Comments at 1-3; Hypres Comments at 5; SDR Forum Comments at 2.

<sup>5</sup> Cingular Comments at 3. *Accord* BellSouth Comments, ET Docket No. 00-47, at 4-6 (June 14, 2000); Ericsson Comments, ET Docket No. 00-47, at 3 (June 13, 2000); Motorola Comments, ET Docket No. 00-47, at iv, 27-31 (June 14, 2000); Nokia Comments, ET Docket No. 00-47, at 7 (June 14, 2000); Nortel Comments, ET Docket No. 00-47, at ii, 4, 10-12 (May 4, 2000) (“Nortel Comments”); SBC Comments, ET Docket No. 00-47, at 14 (June 14, 2000); BellSouth Reply Comments, ET Docket No. 00-47, at 3-5 (July 14, 2000).

Based on the foregoing, SDRs certainly will not eliminate the need for uniform spectrum allocations as Clearwire Technologies, Inc. (“Clearwire”) alleges.<sup>6</sup> Cingular agrees with AT&T that the Commission should reject such an “open range” approach to spectrum management.<sup>7</sup> The Commission should not change its spectrum allocation and management policies based on the *mere possibility* of improvements.<sup>8</sup>

## **II. CLASS III PERMISSIVE CHANGES SHOULD BE LIMITED TO SOFTWARE MODIFICATIONS**

Virtually all commenters supported the Commission’s proposal to foster SDR development by creating a new type of permissive change — Class III changes<sup>9</sup> — and most commenters addressing the issue (including Cingular) support the Commission’s tentative conclusion that such changes should be limited to software modifications.<sup>10</sup> SDR technology is still in its infancy and it is difficult to predict the RF characteristics of a SDR.<sup>11</sup> Thus, until the Commission and the wireless industry develop a better

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<sup>6</sup> Clearwire Technologies, Inc. Comments at 2.

<sup>7</sup> AT&T Wireless Services, Inc. Comments at 6-8.

<sup>8</sup> Cingular Comments at 3; AT&T Wireless Comments at 6 (noting that the NPRM and a majority of *NOI* commenters oppose changing the FCC’s spectrum allocation and management policies based on SDR deployment). As Cingular advanced in its comments, even if SDR did produce such improvements, spectral efficiency is only one of the factors associated with the Commission’s core spectrum management function. The other key element of this function is spectrum allocation. The Commission should not emphasize the potential for spectrum efficiency at the expense of additional spectrum allocations. Cingular Comments at 3.

<sup>9</sup> *See, e.g.*, Cingular Comments at 5; AirNet Comments at 3-4; API Comments at 4; AT&T Wireless Comments at 2-3; Clearwire Comments at 5-6; Federal Law Enforcement Wireless Users Group (“FLEWUG”) Comments at 4-5; Intel Comments at 2; Hypres Comments at 6; Nortel Comments at 5. *See also* NTIA Comments at 4.

<sup>10</sup> *See NPRM* at ¶26; Cingular Comments at 5; AirNet Comments at 5; API Comments at 7; Elite Electronic Engineering Company Comments at 2; FLEWUG Comments at 5; Hypres Comments at 6-7, 9. *But see* Nortel at 3-4.

<sup>11</sup> *See NPRM* at ¶18.

understanding of the RF characteristics and interference potential of SDR, the Commission should limit Class III permissive changes to software changes. The Commission can revisit the issue and expand the category of Class III changes after a few years of widespread SDR use.

Moreover, the concept of SDR is that the operating parameters of a radio can be changed simply by modifying the software.<sup>12</sup> Thus, the proposed rules are designed to facilitate these *software* changes.<sup>13</sup> Changes to *hardware* should not be permitted — if hardware changes are necessary, the radio is not “software defined.” Cingular may not be opposed to broadening the definition of Class III changes in the future (after gaining interference experience with SDRs) to permit both hardware and software changes. However, today such changes are outside the SDR definition and should stay that way.

### **III. ALL HARDWARE AND SOFTWARE COMBINATIONS MUST BE TESTED AND APPROVED BY THE FCC PRIOR TO DEPLOYMENT**

SDR devices will likely support multiple modes of operation, with each mode having potentially different RF emission characteristics. Accordingly, Cingular fully supports the Commission’s proposed testing and approval process. It is vitally important that the Commission fully test all modes of operation possible on an SDR device. Such a procedure is necessary to ensure that software changes affecting the RF emission characteristics of a device do not cause interference to licensed operators. In analogous situations where the Commission has established “secondary” services, the Commission has held that there must be “conclusive” proof that harmful interference will not occur.<sup>14</sup> The Commission should assess

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<sup>12</sup> See *NPRM* at ¶4.

<sup>13</sup> *NPRM* at ¶¶19-21.

<sup>14</sup> *Operation of NGSO FSS Systems*, ET Docket No. 98-206, *Notice of Proposed Rulemaking*, 14 F.C.C.R. 1131, 1139, 1181 (1999); *FM Translator Stations*, MM Docket No. 88-140, *Report and Order*, 5 F.C.C.R. 7212, 7213, 7230 (1990).

appropriate forfeitures when interference is caused by an SDR device that is not operating in accordance with its authorized parameters.

Commenters generally support the Commission’s tentative conclusion that “each combination of hardware and software that a radio supports” be tested and receive FCC approval prior to deployment.<sup>15</sup> The Commission correctly noted that this approach “is the only way at the present time to prevent interference and to protect users from excessive RF radiation.”<sup>16</sup> Moreover, such a requirement would be “no more burdensome than the current process which requires testing each mode in which a radio operates.”<sup>17</sup> Cingular agrees that this approval process should include the actual submission of the software. As noted by the American Petroleum Institute (“API”), the submission of the software is necessary to ensure that the Commission has access to the software for analysis and enforcement purposes.<sup>18</sup>

The Commission should reject all suggestions to narrow the scope of the proposed testing requirements.<sup>19</sup> In particular, the Commission should deny requests to bifurcate the term “software” into

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<sup>15</sup> *NPRM* at ¶18; Cingular Comments at 5; Clearwire Comments at 4; AirNet Comments at 2; SDR Forum Comments at 3, 5; Elite Engineering Comments at 1 ; FLEWUG Comments at 2; Hypres Comments at 6-7; NTIA Comments at 3-5. *See* Vanu Comments at 1-2, 5. Cingular agrees with the Commission that it is premature to rely on manufacturer self-certification. *NPRM* at ¶ 24; Cingular Comments at 7. *See* AT&T Wireless Comments at 5-6; Elite Engineering Comments at 1-2. Self-certification should only be considered after the Commission gains experience with the technology. *NPRM* at ¶33. NTIA estimates that this process should take approximately two years. NTIA Comments at 6-7.

<sup>16</sup> *NPRM* at ¶18.

<sup>17</sup> *NPRM* at ¶18; *see* AirNet Comments at 2; NTIA Comments at 4; SDR Forum Comments at 3.

<sup>18</sup> API Comments at 6. *But cf.* AirNet Comments at 5; Clearwire Comments at 5, 7; Nortel Comments at 6.

<sup>19</sup> The only modification to the SDR definition that is warranted at this time is the *exclusion* of radios that use software simply to switch between different modes of operation that have different hardware-defined power or frequency parameters. Cingular Comments at 4. This appears to be the intent of the

“signal processing software” and “platform software” and to only require manufacturers to test hardware together with platform software.<sup>20</sup> Permitting signal processing software to be tested and approved separately from hardware and platform software may cause unintended interference. Moreover, bifurcating software into these two categories is likely to cause unnecessary confusion regarding which category covers a particular software modification.<sup>21</sup>

#### **IV. ALL SDR EQUIPMENT SHOULD HAVE SAFEGUARDS PREVENTING UNAUTHORIZED MODIFICATIONS AND THE COMMISSION SHOULD IMPOSE STIFF PENALTIES WHENEVER SUCH MODIFICATIONS ARE MADE**

Given the interference potential of SDRs, the Commission should adopt rules that both deter unauthorized modifications and facilitate the detection of such modifications. At a minimum, these rules should require that: (i) the equipment authorization clearly indicate whether the device is an SDR;<sup>22</sup> (ii) the Commission should issue public notices describing all changes to a previously authorized SDR (whether Class III or other changes);<sup>23</sup> and (iii) all SDRs contain an electronic label specifying the current hardware/software combination deployed.<sup>24</sup> As noted in Cingular’s comments, however, the best way for

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footnote following the definition in the *NPRM*. *NPRM* at ¶ 21, n.37.

<sup>20</sup> Vanu Comments at 5-8; Clearwire Comments at 4-5. The Commission also should reject Intel’s proposal to exclude software programs that do not alter the operating parameters of a radio from the definition of SDR. Intel Comments at 6; SDR Forum Comments at 3-4.

<sup>21</sup> For these same reasons, Cingular opposes specific reference to middleware and firmware in the SDR definition. Nortel Networks Inc. Comments at 4. The current definition of SDR appropriately uses the general term “software” which Cingular believes would include both middleware and firmware. By specifically referencing these categories, however, the Commission may needlessly create controversy whether it intended to exclude other categories of software by their omission from the definition.

<sup>22</sup> AirNet Comments at 4; API Comments at 6.

<sup>23</sup> AT&T Wireless Comments at 2-3.

<sup>24</sup> Cingular Comments at 7-8; API Comments at 4; SDR Forum Comments at 8; Elite Engineering Comments at 2; Hypres Comments at 6, 9-10; NTIA Comments at 7, 9; *see* AirNet Comments at 5-6.

accomplishing these objectives is to withhold the equipment authorization until the manufacturer can demonstrate that the SDR contains safeguards that will prevent unauthorized software modifications.<sup>25</sup> “Unauthorized software modifications” should be defined as the installation of any software on an SDR that produces a combination of hardware and software not previously approved by the Commission. Importantly, this language would make it illegal to *load* unauthorized software onto an SDR.<sup>26</sup> Adoption of this language will place manufacturers on clear notice that adequate security mechanisms must be integrated into SDR equipment.

Cingular also agrees with those commenters that propose limiting Class III permissive changes to the entity that obtained the initial SDR authorization.<sup>27</sup> Although permitting third-party modifications may foster competition, it may do so at the expense of interference protection. Third-party vendors are unlikely to match the knowledge of the manufacturer with respect to the hardware/software relationship of a particular SDR. Although a third-party may be able to develop non-interfering software modifications for SDRs, there also is a substantial risk that such modifications will cause interference or result in poor performance. Moreover, it will be difficult to prove who is responsible for the interference. Was the interference caused by the software modification or some other SDR component that was not modified? Accordingly, the Commission should limit Class III changes to the party that originally obtained the SDR authorization. At a minimum, if third-parties are permitted to make modifications, the Commission’s rules

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Clearwire’s proposal — to require SDRs to display an FCC ID which could then be looked up in an FCC database to determine all approved software configurations — should be rejected as too cumbersome. *See* Clearwire Comments at 6-7. Moreover, the SDR label should clearly indicate what hardware/software combination is currently deployed on the SDR.

<sup>25</sup> Cingular Comments at 6-8. Accord API Comments at 5-8; NTIA Comments at 6.

<sup>26</sup> *See* API Comments at 6. Accord Hypres Comments at 10-11; NTIA Comments at 5-6.

<sup>27</sup> AirNet Comments at 4-5; AT&T Wireless Comments at 2-3; API Comments at 4.

should make the third-party responsible for *all* interference caused by the SDR after the modification has been made.

To the extent interference is caused or unauthorized modifications are made, the Commission should issue appropriate forfeitures. The prevention of interference is the Commission's core function and should be dealt with seriously. The mere revocation of an SDR authorization is not a sufficient penalty because the manufacturer will still keep the monetary benefit associated with the sale of the offending SDRs and, more importantly, it will be difficult to identify and remove all of the manufacturer's SDRs.<sup>28</sup>

### **CONCLUSION**

For the foregoing reasons, as well as those contained in Cingular's comments, the Commission should modify its rules both to facilitate the development and deployment of SDRs and to protect existing users from interference from SDR operations. With respect to interference protection, the Commission's rules should (i) restrict Class III permissive changes to software modifications; (ii) require the testing and

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<sup>28</sup> See Cingular Comments at 6; AT&T Wireless Comments at 4.

approval of all hardware and software combinations prior to deployment; and (iii) require that all SDRs have safeguards prohibiting unauthorized modifications.

Respectfully submitted,

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